

Management Plan for the Beach Pinweed (*Lechea maritima*) in Canada

Beach Pinweed



2013

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PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed Special Concern species and are required to report on progress within five years.

The Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers for the management of the Beach Pinweed and have prepared this management plan, as per section 65 of SARA. It has been prepared in cooperation or consultation with the Governments of New Brunswick and Prince Edward Island, the Mi'kmaq Confederacy of Prince Edward Island (MCPEI).

Success in the management of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Environment Canada, the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this management plan for the benefit of the Beach Pinweed and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGMENTS

This management plan was prepared by Sean Blaney of the Atlantic Canada Conservation Data Centre (AC CDC). It was done in collaboration with Samara Eaton of the Canadian Wildlife Service of Environment Canada, Maureen Toner of the New Brunswick Department of Natural Resources, Rosemary Curley, PEI Department of Environment, Energy, and Forestry, Parks Canada Agency staff including: Eric Tremblay, Phil McCabe, Deborah Austin, David Mazerolle from the AC CDC, as well as Randy Angus from the Mi'kmaq Confederacy of Prince Edward Island, who all provided valuable input and comments. Contributions were also made by Dr. Ken Richards, Research Manager, Canadian Genetic Resources Program, Agriculture and Agri-Food Canada, Saskatoon.

EXECUTIVE SUMMARY

Beach Pinweed (*Lechea maritima*) is an herbaceous perennial plant in the Rockrose family Cistaceae occurring on coastal sand dunes. In Canada it is restricted to small portions of the Gulf of St. Lawrence shores of New Brunswick and Prince Edward Island and Canadian populations have been recognized as a globally rare, endemic variety, the Gulf of St. Lawrence Beach Pinweed (*Lechea maritima* var. *subcylindrica*). Since this is the only variety of *Lechea maritima* in Canada, the Beach Pinweed is listed by COSEWIC at the species level, but Gulf of St. Lawrence Beach Pinweed has 100% of its global population in Canada.

Beach Pinweed is only minimally affected by direct anthropogenic impacts because there is very little human development in occupied dunes and further development in dunes is regulated by provincial authorities. An estimated 65% of the Canadian population is within protected areas. There are, however, indications that it may be declining in response to increased storm frequency and intensity that is likely linked to climate change and that climate change-related impacts on the species are likely to increase through the future. The largest Canadian populations of the species are within Kouchibouguac National Park, along with large occurrences to the south near Richibucto and Bouctouche, New Brunswick which collectively represent 71% of the Canadian population. These areas are believed to be the most susceptible to storm impacts because of their occurrence only a few metres above sea level on low dune systems. Habitat changes and population declines caused by storm impacts have already been observed within these occurrences over the past seven years and are likely to increase with predicted sea level rise and increased storm frequency and intensity.

The management objectives for Beach Pinweed are: 1) to document and maintain existing populations independent of any changes that may be caused by severe storm impacts; and 2) to minimally safeguard all populations against potential future extirpation by preservation of seeds in a long-term, *ex situ* seed bank facility. Conservation *ex situ* is necessary in this case because the only known major threat to the species in Canada is storm impacts on Beach Pinweed's dune habitat, related to climate change and thus direct, on-site mitigation is not possible.

Conservation measures in this plan fall into four broad strategies: 1. population monitoring and surveys of undocumented sites, 2. *ex situ* preservation of Beach Pinweed seeds as a precaution against local extirpation, 3. outreach and stewardship with land owners, managers and the public, and 4. research. Seed collection and long-term storage, surveys of unsurveyed or undersurveyed potential habitat, and contact and education of all land owners and managers of Beach Pinweed sites are high priority measures.

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1. COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: April 2008

Common Name (population): Beach Pinweed

Scientific Name: *Lechea maritima*

COSEWIC Status: Special Concern

Reason for Designation: The Canadian populations have been recognized as an endemic variety of global significance. Plants are restricted to stabilized sand dunes within localized areas of coastline in New Brunswick and Prince Edward Island. The majority of the 15 populations, including the three largest, occur at elevations under 5 m above sea level. Here they are at increased risk from the impacts of severe storm surges resulting from rising sea levels and increased storm frequency and intensity predicted to occur as a consequence of climate change. A recent storm surge has already impacted a substantial portion of potential habitat at one of the New Brunswick sites. Other impacts have also been documented as a consequence of trampling, all terrain vehicle use, and successional changes to the species' habitat.

Canadian Occurrence: NB, PE

COSEWIC Status History: Designated Special Concern in April 2008

*Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

Beach Pinweed is considered Globally Secure (G5) at the species level, but the Canadian population is considered a taxonomically distinct and globally imperilled variety (*Lechea maritima* var. *subcylindrica*, G5T2) endemic to the Gulf of St. Lawrence shores of New Brunswick and Prince Edward Island (NatureServe 2011). Gulf of St. Lawrence Beach Pinweed has 100% of its global population in Canada. Beach Pinweed has a national rank of imperilled (N2) in Canada (NatureServe 2011), and a National General Status rank of Sensitive (CESCC 2010). It has a provincial rank of imperilled (S2) in New Brunswick and critically imperilled (S1) in Prince Edward Island (NatureServe 2011) and provincial General Status ranks of Sensitive in New Brunswick and May Be At Risk in Prince Edward Island.

3. SPECIES INFORMATION

3.1. Species Description

Beach Pinweed (*Lechea maritima*) is an herbaceous perennial in the Rockrose family Cistaceae occurring on coastal sand dunes within a very narrow zone of dune succession at which dunes are fairly stabilized and typically have a moderate to high cover of dwarf shrubs. The Canadian populations have been recognized as a globally rare, endemic variety, the Gulf of St. Lawrence Beach Pinweed (*Lechea maritima* var. *subcylindrica*). Since this is the only variety of *Lechea maritima* in Canada, the Beach Pinweed is listed by COSEWIC at the species level. The species has prostrate, densely leafy basal shoots developing from the woody base, often forming a rosette. Flowering stems are 20-35 cm tall, usually erect and extensively branched. Plants flower in mid to late summer and develop fruit in late summer and early fall. The numerous, inconspicuous flowers have three short-lived, reddish-brown petals and develop into a small, round, 3-valved capsule containing 4-5 seeds. Stems are firm and can remain erect well into winter and seeds may be released into the following year. Soil seed banking is known in some pinweeds (i.e. Maliakal Witt 2004), but has not been investigated in Beach Pinweed. The species appears relatively long-lived and seedlings are infrequent in most populations, but there is no further demographic information available. Beach Pinweed is best distinguished from the other pinweed in its Canadian range (Narrowleaf Pinweed, *Lechea intermedia*) by the densely white-hairy undersides of its basal leaves, white-hairy flowering stem and smooth seeds.

3.2. Populations and Distribution

Beach Pinweed (*Lechea maritima*) occurs from New Brunswick to North Carolina, extending about 150 km inland in Massachusetts and New Hampshire, but otherwise occurring almost exclusively along the Atlantic coast (Figure 1). The variety *subcylindrica* is endemic to the southern Gulf of St. Lawrence, on New Brunswick's eastern coast and Prince Edward Island's northern shore (Figure 2). On Prince Edward Island, almost all populations occur along 41 km of shoreline in Malpeque and Cascumpec Bays, with a single occurrence 54 km west. In New Brunswick, occurrences are spread over an 87 km straight-line distance, between Miramichi Bay and Bouctouche Bar.

Beach Pinweed occurs at 8 sites in New Brunswick and 7 sites in Prince Edward Island with the total population size estimated to be 181,000+ individuals. Data prior to 2003 is insufficient in detail to determine if populations have undergone growth or decline. Table 1 lists each site with population size estimates, length of occurrence, and the date of first discovery and most recent observation. Population sizes in New Brunswick are highly variable, ranging from small scattered patches in the northern populations at to denser and much more extensive populations of tens of thousands in the Kouchibouguac and Richibucto dune system. Prince Edward Island population sizes are more consistent, with the exception of the large occurrence on Hog Island's southern section.

An important aspect of the distribution of Beach Pinweed is that approximately 60% of the Canadian population is located within protected areas at Kouchibouguac National Park (~55% of Canadian population), Prince Edward Island National Park (~3%), Cabot Beach Provincial Park in Prince Edward Island (~1%) and the Portage Island National Wildlife Area (<1%).

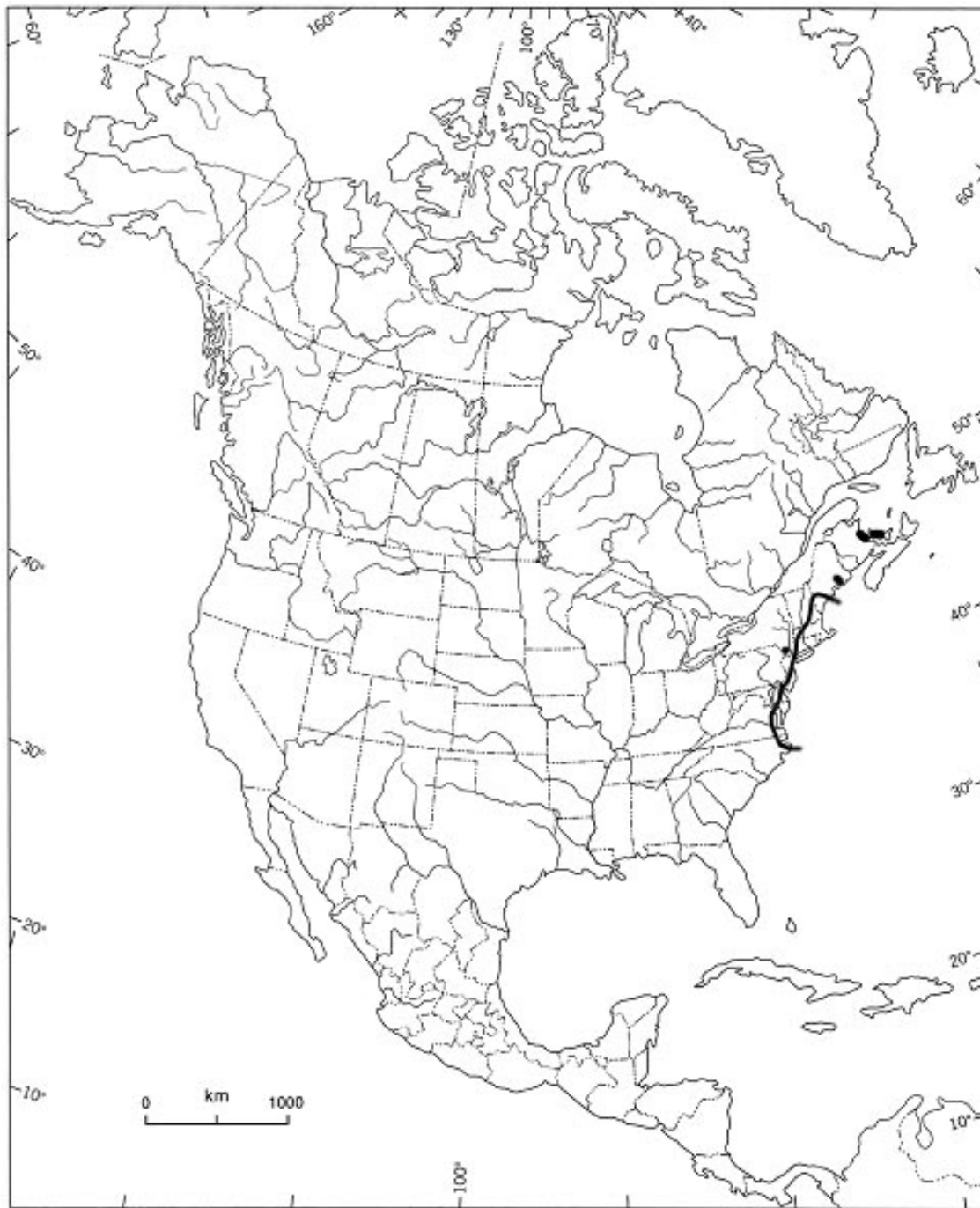


Figure 1. Global range of Beach Pinweed (*Lechea maritima*). Canadian populations are variety *subcylindrica*, Virginia and North Carolina populations are variety *virginica*, and the remainder are variety *maritima*.

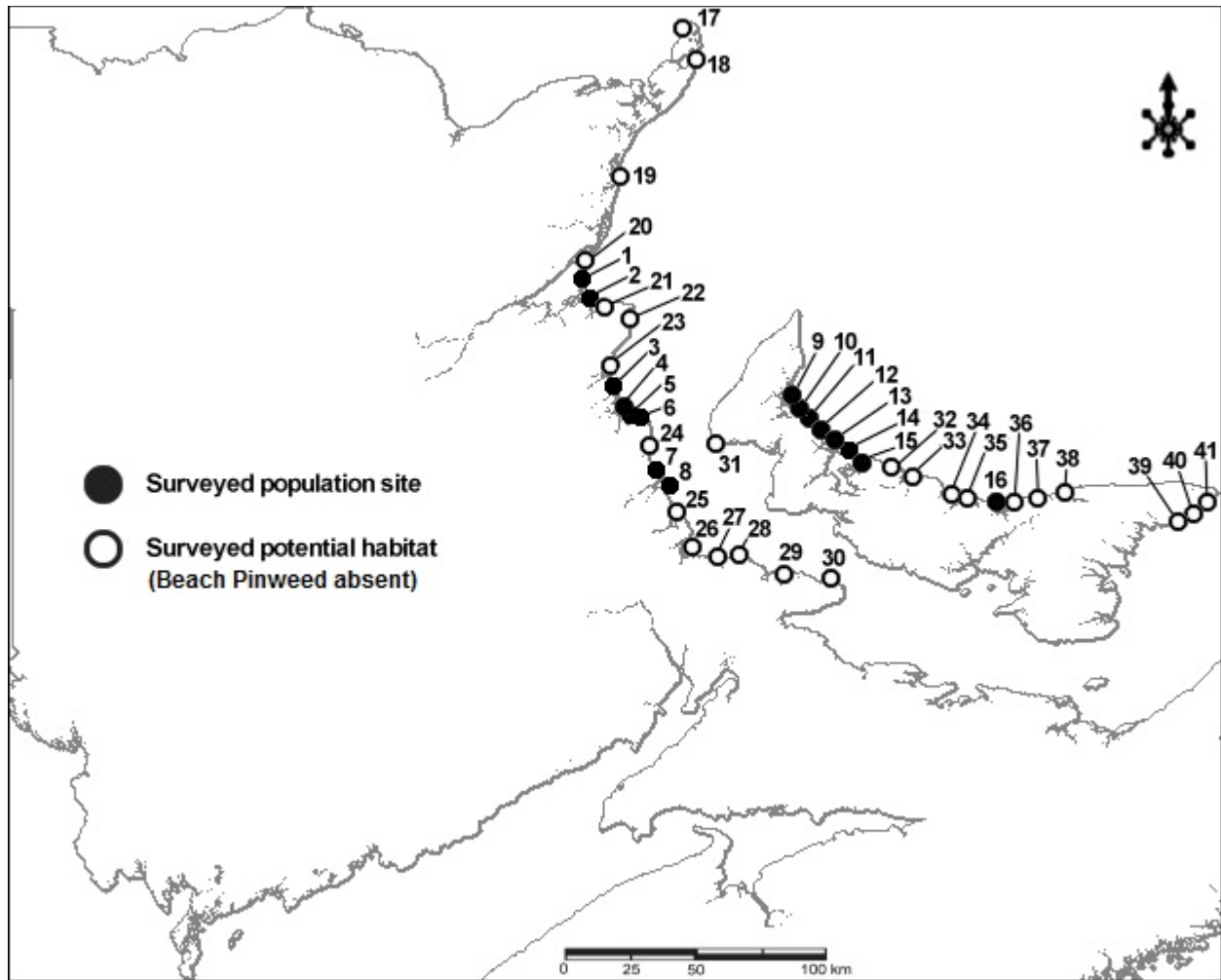


Figure 2. Canadian range of Beach Pinweed (*Lechea maritima*), with 2002-2006 surveyed potential dune habitat sites where Beach Pinweed was absent. Site numbers 1 to 16 correspond to those in Table 1. Site numbers 17 to 41 are: 17. Grande Plaine, NB; 18. Chiasson Lighthouse, NB ; 19. Île-au-Cheval, NB; 20. Neguac Dune, NB; 21. Preston Beach, NB; 22. Escuminac Beaches, NB; 23. North Kouchibouguac Dune, NB ; 24. Chockpish Beaches, NB; 25. Cocagne Island, NB; 26. Shediac Island – Grande Digue, NB; 27. Cap-Brûlé – Cap-Bimet, NB; 28. Aboiteau Provincial Park, NB; 29. Grants Beach, NB; 30. Cape Jourimain Natl. Wildlife Area, NB; 31. Cedar Dunes, PE; 32. Campbells & Cousins Ponds, PE; 33. Cavendish Beach, PE; 34. Rustico Island, PE; 35. Brackley Beach, PE; 36. Deroche, PE; 37. Crowbush, PE; 38. Cable Head, PE; 39. Black Pond, PE; 40. Basin Head, PE; 41. South Lake , PE

Table 1. Population size and length of occurrence for Canadian populations of beach pinweed, with dates of first and last observations. Site numbers correspond to those in Figure 2.

Site #	Site name	Province	Pop. size Estimate	Length of Occurrence	Notes	Date First Observed	Date Last Observed
1	Portage Island	NB	250-500	5 patches known over 3 km, one ~continuous over 0.15 km, others very small	Likely more plants present in forest, though definitely uncommon on island	1913	2004
2	Fox Island	NB	~220	~ Continuous over 0.28 km + single point occurrence	South 4.3 km of island was not surveyed	1892	2005
3	South Kouchibouguac Dune, Kouchibouguac National Park	NB	>50,000	~ Continuous over 4 km		1913	2009
4	North Richibucto Dune, Kouchibouguac National Park	NB	>50,000	Discontinuous over 7.5 km		2002	2009
5	South Richibucto Island	NB	>10,000	~ Continuous over 1.3 km		1913	2005
6	South Richibucto Dune	NB	~8,000	~ Continuous over 4 km		1913	2010
7	Bouctouche Dune (north section)	NB	~5,000	~ Continuous over 1 km	North vs. South Bouctouche Dune not specified in 1932 record	1932	2009
8	Bouctouche Dune (south section)	NB	~5,000	~ Continuous over 3 km		2003	2009
9	Cascumpec Sandhills	PE	~250	Discontinuous over 0.06 km	Northern 3.3 km of island, was not surveyed	2005	2005
10, 11	Conway Sandhills (north section)	PE	~5,000	Discontinuous over 4.9 km & ~ Continuous over 1.5 km	A 2.8 km segment, likely supporting pinweed, was not surveyed	2003	2005
12	Conway Sandhills (south section)	PE	>3,500	~ Continuous over 1.5 km		2006	2006
13	Hog Island (north section)	PE	~740	Discontinuous over 1 km	Northern 3.2 km of island, likely supporting pinweed, not surveyed	2006	2006
14	Hog Island (south section)	PE	35,500+	~ Continuous over 1.1 km + 0.7 km	Population value includes very dense occurrence of young but reproductive plants; South 2 km of island, likely supporting pinweed, not surveyed	1984	2005
15	Cabot Beach Provincial Park	PE	~1,500	~ Continuous over 0.18 km + Discontinuous over 0.16 km		2005	2006
16	Blooming Point, Prince Edward Island National Park	PE	~6,000	~ Continuous over 0.4 km		2006	2006

3.3. Needs of the Beach Pinweed

Beach Pinweed is strictly coastal in Canada, occurring on large and relatively stabilized barrier dune systems, mostly in unforested, sandy habitats with little or no soil profile development, limited moisture and low nutrient levels.

The species is apparently unable to tolerate conditions on highly active dune sections and on some dense, low shrub dunes as in the Broom-Crowberry (*Corema conradii*) dominated portions of Hog Island, Prince Edward Island. Most known populations occur on sites offering some protection from the full intensity of onshore winds, salt spray and storm-related sand deposition and overwash. Typical locations include the landward slopes of foredunes, stable secondary dune crests, and dry interdune and backdune plains. These habitats often have substantial cover of low shrubs, especially Beach-Heather (*Hudsonia tomentosa*), often with Bearberry (*Arctostaphylos uva-ursi*), while adjacent unoccupied areas are more thoroughly dominated by the more disturbance-tolerant American Beachgrass (*Ammophila breviligulata*). The herbaceous layer of Beach Pinweed sites is usually sparse American Beachgrass with species such as Sea-beach Sedge (*Carex silicea*), Shaved Sedge (*Carex tonsa*), Beach Pea (*Lathyrus japonicus*), New York Aster (*Symphyotrichum novi-belgii*) and Seaside Goldenrod (*Solidago sempervirens*), and there is often significant lichen cover. The species is naturally limited by its highly specialized habitat.

Beach Pinweed habitat differs on Miramichi Bay islands where, in addition to more typical habitats, the species occurs on old dunes well back from the shore in open woodland dominated by Jack Pine (*Pinus banksiana*) and Red Pine (*Pinus resinosa*) with White Pine (*Pinus strobus*), Grey Birch (*Betula populifolia*) and Trembling Aspen (*Populus tremuloides*) and with an understory of Beach-Heather, Bearberry and lichens. Populations in forested sites are smaller than other New Brunswick sites, and the fact that plants are limited to the most open areas of forest suggests that this habitat may be suboptimal because of shading by tree cover.

3.4. Threat Assessment

Table 2. Threat assessment table.

Threat	Level of Concern ¹	Extent	Occurrence	Frequency	Severity ²	Causal Certainty ³
I. Climate and Natural Disasters						
A. Storm events (increased frequency and intensity - potentially linked to climate change)	High	Widespread	Current	Recurrent	Moderate-High	Medium
II. Disturbance or Harm						
A. Off Highway Vehicle (OHV) traffic	Medium-Low	Localized	Current	Continuous	Low	Medium-Low
B. Dredging	Low	Localized	Historic / Current	Seasonal	Unknown	Unknown
C. Trampling / Campsites	Low	Localized	Current	Continuous	Low	Low
D. Unauthorized construction on dunes	Low	Localized	Unknown	One-time	Low	High
III. Natural Processes or Activities						
A. Canopy closure in forested occurrences	Medium	Localized	Current	Continuous	Low	Medium
B. Hybridization with Narrowleaf Pinweed	Low	Unknown	Unknown	Unknown	Unknown	Low

¹ *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the conservation of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

² *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

³ *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

3.5. Description of Threats

Threats are presented in order of decreasing level of concern:

Dune habitat loss to storm impacts (potentially linked to climate change) (Threat I A)

There is now general scientific consensus that human-caused climate change is increasing global temperature, causing sea-level rise and increased storm frequency and severity (Environment Canada 2006, IPCC 2007). Documented changes in Gulf of St. Lawrence climate and coastal dune systems may be linked with human-caused climate change, including: 1) a statistically significant increase in severe windstorms since the 1980s (Parkes et al. 2006), resulting in

increased flooding, erosion and breaching of coastal barrier dunes (Environment Canada 2006); and 2) a net decrease in the amount of beach and dune habitat on New Brunswick's southeast coast from 1944 to 2001 (O'Carroll *et al.* 2006, from the area just south of Beach Pinweed range). This decrease has been observed also on the North Richibucto Dune (KNP) where the dune habitat showed a net decrease of 11 hectares between 1995 and 2002. The South Kouchibouguac Dune had a decrease of dune habitat in its northern tip, an increase in its southern parts, and the central zone remained stable during the same time period (Arcand, 2007). The phenomenon of southern migration of dune habitat and gullies has been observed by Dagneau (1996) in KNP and by Ollerhead (1993) on the Bouctouche Dune. Dagneau (2004) measured a net landward movement of the dunes of Prince Edward Island and Kouchibouguac National Parks since the late 1990s in association with an increase in storm events.

A multiyear analysis of aerial photographs conducted in Kouchibouguac National Park demonstrated that South Kouchibouguac Dune has been in erosion mode between 1974 and 2002 with an annual average erosion rate of 1.0 m (+/- 0.21 m) (Arcand 2007). Between 1995 and 2002 (the last portion of the study) this annual rate was 1.48m (\pm 0.84 m) showing an increase in erosion during this period (Arcand, 2007). The average erosion rate for the North Richibucto Dune was less than 1.0 m per year between 1996 and 2000 (Dagneau, 2004). For the Bouctouche Dune the average erosion rate is lower than in Kouchibouguac with 0.3 m/year (Ollerhead, 1993). In PEI, an assessment of aerial photographs from 2000 and 2010 at PEI's Cabot Beach sandspit indicate that the spit is changing shape rapidly and has lost length of 70m over the past 10 years, an erosion a rate of 7m/annum (Curley, pers. comm. 2011).

Increased storm frequency and severity combined with higher sea levels can change some Beach-Heather – Beach Pinweed communities to American Beachgrass-dominated communities that are less suitable or completely unsuitable for pinweed. Storm erosion effects are also not necessarily limited to those areas subjected to direct flooding, as erosion at lower elevations can destabilize the dune crests above and cause changes in their plant communities.

Published and unpublished evidence suggests many barrier dunes are narrowing in Prince Edward Island (Curley, pers. comm. 2007) and in New Brunswick's Kouchibouguac (Tremblay, pers. comm. 2007) and Bouctouche areas (Ollerhead, 1993), where several Beach Pinweed sites have been notably modified by intense storms since 2000.

Dunes are naturally dynamic and all dune specialist plants must be adapted to some extent to cope with dune movement and sand deposition. It is unclear whether observed declines in Beach Pinweed associated with recent storm events are permanent and whether the species will be able to colonize stabilized dune communities that may develop in new locations in the future.

There is, however, enough modeling of sea level rise and increase in inundation frequency (see *Threats* section in COSEWIC 2008) to raise concern over the persistence of Beach Pinweed in the face of climate change impacts, especially on the relatively low dunes of New Brunswick's Kouchibouguac, Richibucto and Bouctouche areas which support the largest populations. Most pinweed populations on Miramichi Bay, NB and Prince Edward Island are at slightly higher elevations or are protected by higher foredunes, so any impacts would likely be later and/or less severe.

Canopy closure in forested occurrences (Threat III A)

Succession could be causing habitat and population declines in the New Brunswick Fox and Portage Island sites, the only ones where pinweed occurs under tree cover. Early records from the sites do not document abundance but local residents indicate that Portage Island has become substantially more wooded over the past 40 years and the same situation likely applies to Fox Island. At Fox Island, plants at one of the two subpopulations were only observed within and along the edge of an OHV trail where light levels were higher than in the surrounding area, suggesting that shading by trees and tall shrubs may have been limiting occurrence elsewhere. Populations at these sites are relatively low and, especially at Fox Island where no plants were found in open habitats, could be lost over time.

Off-highway vehicle traffic (Threat II A)

Off-highway vehicle (OHV) use in coastal ecosystems such as dunes and wetlands is frequent in New Brunswick and Prince Edward Island despite legal prohibition and other deterrents. On dunes, new trails can quickly develop after just a few passes of an OHV and even the more remote island sites can be accessed by OHVs over ice in winter or carrier boats in the summer. Thus OHV impacts are a potential threat to most Beach Pinweed populations. However, recently used vehicle trails have been observed in Beach Pinweed populations only at the South Richibucto Dune and one of two portions of the Fox Island population. Monitoring for future OHV impacts will be important.

OHV impacts were most notable at the South Richibucto Dune population, where recreational use is frequent and vehicle tracks passed through several large patches of Beach Pinweed, causing several blowouts. Beach Pinweed plants were observed at the edge of tracks but were generally absent within them, indicating a loss of individuals (D.M. Mazerolle, pers. obs. 2003).

Dredging (Threat II B)

In the past, particularly at Cabot Beach Provincial Park site, dredging spoils have been deposited on land in and adjacent to the areas of the beach where this species is known to occur. Although currently dredging spoils at this location are deposited at sea, it is still a potential threat, as dredging continues to occur annually in this location and it is possible that land disposal of spoils could be requested or desired in some instances. Another concern associated with dredging at this site is the potential impact it might have on the natural sand deposition at this site, however, this will require additional investigation (Curley, pers. comm. 2011).

Trampling/ camping and unauthorized construction on dunes (Threat II C and D)

Pedestrian trampling causing destruction of Beach Pinweed plants has been observed at the South Kouchibouguac Dune and Bouctouche Dune populations (Mazerolle, pers. obs.), both of which are very popular beach destinations, but effects remain very small relative to the entire populations. Most other sites except for Cabot Beach Provincial Park are likely too remote and infrequently visited for trampling to be a significant factor, although occasional camping or unauthorized construction of cabins (which has been frequent in some barrier dune systems in New Brunswick and was observed on the Cascumpec Sandhills in 2006 away from Beach Pinweed populations) could certainly affect individual occurrences.

Hybridization (Threat III B)

Hybridization can threaten rare plant species through the wasting of reproductive cells (gametes), reduced seed-set, poorly adapted progeny and genetic swamping (homogenization of local genotypes) (Levin et al. 1996), especially in locations where a non-rare species is much more abundant than a rare species with which it can hybridize. According to Hodgdon (1938), Beach Pinweed commonly hybridizes with other pinweeds including Narrowleaf Pinweed, which occurs in close proximity to Beach Pinweed at Hog Island, Cabot Beach Provincial Park and on the northern section of the Bouctouche Dune. The threat of hybridization is a strictly theoretical one at present. No evidence of hybridization has been observed in Canada, although hybrids are reported to bear close resemblance to either parent plant and to be hard to detect (Hodgdon 1938). The threat of hybridization is likely also reduced by the fact that Beach Pinweed outnumbers Narrowleaf Pinweed at the sites in which they occur in the vicinity of one another.

4. MANAGEMENT OBJECTIVES

The management objectives for Beach Pinweed are:

- 1) to maintain existing populations, excluding impacts of severe storms since they cannot be mitigated;
- 2) to establish an *ex situ* seed bank

The preservation of seeds in a long-term *ex situ* seed bank facility is necessary to minimally safeguard all populations against potential future extirpation. *Ex situ* conservation is necessary because direct, on-site mitigation of the major threat to the species in Canada, the impacts of severe storms, is neither feasible nor desirable.

5. BROAD STRATEGIES AND CONSERVATION MEASURES

5.1. Broad Strategies

In order to achieve the management objective, conservation measures will be organized under the following four broad strategies:

1. Population monitoring and surveys of undocumented sites,
2. *Ex situ* preservation of Beach Pinweed seeds as a precaution against local extirpation,
3. Outreach and stewardship with land owners, managers and the public, and
4. Research

5.2. Actions Already Completed or Currently Underway

As noted above under Distribution, an estimated 60% of the Canadian population of Beach Pinweed is within protected areas and an additional 31% is within federal lands on Hog Island. The Mi'kmaq Confederacy of Prince Edward Island and the Lennox Island First Nation are working with conservation agencies to protect sensitive dune habitats on Hog Island. The very high proportion of the population that is within protected areas and federal land should be helpful in ensuring the protection of Beach Pinweed from direct anthropogenic impacts.

The distribution and general abundance of Beach Pinweed in Canada is thoroughly (though not completely) documented through extensive searching of suitable habitat in New Brunswick and Prince Edward Island completed respectively by Bouctouche Dune Irving Eco-Centre in 2004 and 2005 and by the Atlantic Canada Conservation Data Centre in 2005 and 2006. This work has covered virtually all suitable dune habitat south of Miramichi Bay on the east coast of New Brunswick, much of the suitable habitat on Miramichi Bay and the Acadian Peninsula of New Brunswick, and the north and northeast shores of Prince Edward Island. Some suitable habitat remains unsurveyed.

Distribution of known populations is accurately mapped in GIS within the AC CDC's Biotics database, with digital data on all occurrences maintained in Biotics and in the main AC CDC database.

Parks Canada Agency, Atlantic Region, began the process of familiarizing relevant staff with Beach Pinweed and its significance, distribution, identification and ecology through a day-long meeting at Kouchibouguac National Park in July 2008.

Staff of Nature NB's Piper Project are aware of Beach Pinweed and have made some efforts to find it in suitable habitat on the Acadian Peninsula.

5.3. Conservation Measures

The conservation measures necessary to meet the management objective are presented in Table 3 and are organized according to the four broad strategies.

Table 3. Implementation Schedule

No.	Conservation Measures	Priority	Threats or concerns addressed	Timeline
1. Broad Strategy: Population monitoring and surveys of undocumented sites				
1.1	Develop a monitoring plan and standardized protocols for monitoring: population size and trends, distribution, habitat change due to threat (i.e. storms, OHVs), search effort in the field, and for the permanent documentation of results (positive or negative)	High	Lack of information	2013
1.2	Identify sites for monitoring and surveying and prioritize these, including: unsurveyed potential habitat, under-surveyed populations, level of susceptibility to storm impacts	High	Lack of information	2013
1.3	Implement monitoring program at highest priority sites including potential habitat, under-surveyed populations, and populations under the greatest threat	High	Lack of information	2013-2022
1.4	Coordinate and collaborate, where possible, with other dune habitat fieldwork, particularly in monitoring threats and searching for previously undocumented occurrences	Medium	Lack of information	2013-2022
1.5	Investigate possibility of occurrence on Magdalen Islands, Quebec via targeted surveys and through examination of specimens from the Magdalen Islands	Medium	Lack of information	2016

No.	Conservation Measures	Priority	Threats or concerns addressed	Timeline
2. Broad Strategy: Ex situ preservation of Beach Pinweed seeds as a precaution against local extirpation				
2.1	Develop and implement an ex situ conservation plan	High	Storm events linked to climate change	2013-2016
2.2	Finalize seed collection protocol and prioritize seed banking efforts based on the ex situ conservation plan	High	Storm events linked to climate change	2013-2014
3. Broad Strategy: Stewardship, outreach, and management with land owners, land managers and the public				
3.1	Contact land managers and private landowners at all known occurrences and engage them in a variety of stewardship activities	High	OHV traffic, trampling / campsites, unauthorized construction on dunes	2013-2016
3.2	Work with local OHV clubs to inform them of significance of Beach Pinweed and its habitat needs and to investigate means of reducing OHV damage to Beach Pinweed plants	Medium	OHV traffic	2014-2015
3.3	Develop approaches and strategies to reduce trampling of plants, particularly on South Kouchibouguac Dune, Kouchibouguac National Park and the north section of Bouctouche Dune at the Irving Eco-Centre	Medium	Trampling	2013-2014
3.4	Examine approaches to the protection of habitat on private lands, including: conservation easements, donations, and acquisition	Low	All threats	2013-2022
3.5	Increase the awareness of Beach Pinweed, its threats and habitat among targeted audiences who have potential to impact the species and its conservation, and explore the potential for doing this through existing programs via a variety of approaches	Low	OHV traffic, trampling / campsites, Unauthorized construction on dunes	2013-2022
3.6	Work with stakeholders to mitigate impacts of dredge spoil deposition in Cabot Beach Provincial Park	Low	Dredging	2013-2022
3.7	Support enforcement of existing laws and regulations pertaining to threats impacting Beach Pinweed and its habitat	Medium	OHV traffic, unauthorized construction on dunes	2013-2022
3.8	Collaborate and participate, where possible, with projects that are assessing the impacts of storms events and dune migration on the coasts of PEI and NB and incorporate the findings of this research into the management of Beach Pinweed	Low	Storm events linked to climate change	2013-2022
4. Broad Strategy: Research				
4.1	Research key questions in regards to the ecology of Beach Pinweed including life history and demographics	Medium	Lack of knowledge	2013-2022
4.2	Research key questions in regards population genetics and taxonomy as outlined in Section 5.4 below	Low	Lack of knowledge	2013-2022

5.4. Narrative to Support Implementation Schedule

Broad Strategy 1: Documenting and monitoring populations

A population monitoring plan needs to be carefully designed to answer the particular questions determined to be most relevant to understanding the species' status and defining conservation measures. The plan would also need to identify and prioritize the sites for monitoring and surveying based including such factors as: unsurveyed potential habitat, under-surveyed populations, level of susceptibility to storm impacts. The populations on lower dunes in New Brunswick (Kouchibouguac, Richibucto area and Boutouche) are predicted to be most susceptible to storm impacts, and include a high proportion of the Canadian population, thus these populations would be considered a high priority for monitoring efforts.

Several agencies and organizations work regularly adjacent to or within dune habitats in Beach Pinweed's known or potential range and cooperation with fieldworkers from these projects holds some potential to enhance efforts to find previously undetected populations, to confirm presence or absence in unchecked potential habitat, and to monitor known populations, especially with regard to major storm-related impacts or OHV impacts that may be evident at a glance.

Beach Pinweed distribution in Canada is relatively well understood because potential habitat is readily identified on aerial photographs and a high proportion of it within the Maritimes has already been searched. Additional field surveys would, however, still be valuable. Since Quebec's Magdalen Islands are only 120 km from Prince Edward Island populations and support extensive Beach-Heather dominated dunes field work as well as examination of existing herbarium specimens would be valuable.

Broad Strategy 2: Ex situ seed preservation

For most species, conservation measures that directly improve the situation for the species in its natural habitat would be given priority over off-site activities such as *ex situ* seed banking. It is important to note that this plan suggests seed collection and storage only as a precaution against potential future local extirpations and is not proposing reintroduction or augmentation of existing populations at present. Any future effort to reintroduce or augment populations would need to be carefully considered. A *ex situ* conservation plan will be developed and also a complete seed collection protocol will be developed.

Several factors justify the high priority given to *ex situ* seed banking for Beach Pinweed in this management plan: 1) The main potential threat for the species is loss of mature individuals and habitat caused by storm action, the effects of which are believed to be amplified by human-caused increases in sea level and storm frequency and intensity. This threat cannot be directly mitigated with local measures. 2) Beach Pinweed is not significantly threatened rangewide by any other factors, so other conservation measures will have only minor impacts on the species' population as a whole. 3) The existence of long-term seed storage facilities in Canada to partner with, makes *ex situ* seed banking a low cost measure with high potential future benefit in the event that particular populations become extirpated but suitable habitat for reintroduction still exists. This is a conceivable situation if loss of habitat occurs more rapidly than development of new suitable dune habitat and colonization of that habitat by Beach Pinweed.

Broad Strategy 3: Outreach and stewardship with land owners, managers and the public

A first step in stewardship for any species is contacting relevant landowners and managers. It should be a high priority measure to ensure that all of these landowners and managers are contacted and informed of Beach Pinweed, its habitat and threats. A variety of stewardship activities will be developed. Direct anthropogenic impacts on Beach Pinweed appear to be relatively small relative to the whole population at present. The most significant impacts are those of OHVs at the South Richibucto Dune population. Controlling OHV impacts is difficult and will require working with landowner(s) and OHV users, perhaps through local OHV and/or outdoor clubs, to develop strategies that have local support. The other documented specific anthropogenic impacts are from trampling of plants by beachgoers on the South Kouchibouguac Dune at Kouchibouguac National Park and the northern Bouctouche Dune at the Irving Eco-Centre. Options for addressing this threat will be explored and their effectiveness evaluated and monitored. Outreach, targeted at specific audiences that have the potential to impact the species and its conservation, should be conducted via a variety of approaches such as talks to naturalist clubs, internet, local newspapers, etc.

Broad Strategy 4: Research

The key research questions are outlined here to document important knowledge gaps regarding life history and demographics which are important factors in the species ability to recover from storm events. As well as key knowledge gaps regarding ecology and genetics and taxonomy.

Key questions on Beach Pinweed life history and demographics include:

- What is the average time to maturity from seed?
- What is the frequency and extent of reproduction from seed?
- What is the average age of reproductive individuals?
- What is the longevity of mature individuals?
- What is the longevity of seeds in the soil and the importance of soil seed banking to long-term persistence?

Additional questions on Beach Pinweed ecology that would aid in future status assessments and management of the species include:

- What is the nature of the habitat limitations that restrict Beach Pinweed from more active dunes and more densely vegetated areas dominated by low shrubs, tall shrubs or trees?
- How much time and what conditions are required for the development of the stabilized Beach-Heather dominated dunes that appear most suited to Beach Pinweed occurrence?
- What is the typical range of dispersal distances for Beach Pinweed seeds?

Questions on genetics and taxonomy include:

- What is the genetic diversity within and between Canadian populations? This information is essential in identifying priority sites, seed sources and potential for ex situ conservation
- Do Canadian populations differ genetically from those in the main United States range? This relates to the question of how distinct the Gulf of St. Lawrence Beach Pinweed endemic and globally rare variety *subcylindrica* really is. The variety, which was described in 1938, has not been evaluated by more modern taxonomic methods.
- Is there any genetic evidence of hybridization with Narrowleaf Pinweed in Canada and if so, could this threaten Beach Pinweed persistence?

Population Decline in Forested Sites from Canopy Closure

No measure is proposed to mitigate this potential threat at present. Pinweeds are species of open habitats, well adapted to disturbance from fire (*i.e.* Maliakal Witt 2004), so Beach Pinweed populations in forested areas on Portage and Fox Islands would possibly benefit from canopy opening via prescribed burning or tree and shrub removal. However, these would be complex and expensive operations that would be difficult to undertake on National Wildlife Area (Portage Island) or private (Fox Island) land; the total Beach Pinweed population on those islands is estimated to be less than 1% of the Canadian population; and the extent of the positive impact that might result from canopy opening activities is not known, nor are the potential negative impacts on other species. Thus the potential benefits of prescribed burning or tree and shrub removal for Beach Pinweed do not seem sufficient to undertake direct conservation measure at this time.

6. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives for Beach Pinweed. Success of the implementation of this management plan will be evaluated every five years against the following indicators:

- Existing populations of Beach Pinweed maintained
- Securement and long-term storage of Beach Pinweed seeds from across its Canadian range as a precaution against local extirpations by storm impacts

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below in this statement.

This management plan will clearly benefit the environment by promoting the conservation of the Beach Pinweed. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the Species Information section of the document and the implementation schedule.